Sub A17 ~~Elevator with a cage held on a support~~
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The invention relates to an elevator with an elevator cage held on a support, in accordance with the preamble of claim 1.

In the past years elevators for buildings have been developed which can do without an additional machine room for elements of the support and motion unit of the elevator cage. With respect thereto, a drives are known which in flat manner bear on the shaft wall and find room in a lateral area between said wall and the elevator cage.

Motors of this kind are embodied in gearless manner or with the use of special flat-built gears. Such constructions represent special constructions which are connected with correspondingly high cost.

Furthermore, from the German utility model DE 298 65 26 U1 an elevator drive is known, consisting of a pulley and a sheave coaxially correlated thereto, which are combined to form a flat drive wheel connected to the drive motor via a belt drive. By the belt drive a spatial separation is achieved between the pulley acting on the support ropes and a drive motor correlated thereto and effecting movement thereof, so that the drive motor can be arranged in favorable position spaced from said sheave, this permitting a more flexible adaptation to the local conditions.

Since, however, the possibility to realize transmissions to slower movement by means of a one-step belt drive is limited, a drive motor with comparatively strong torque is required. If it is to be done without using a particularly flat-built and costly special construction for the drive motor and instead rather a standard motor is to be used, this obligatorily requires that the motor is built so large that its width in direction of its drive shaft is larger than the width of the drive wheel along the axis of rotation thereof.

In other words it cannot be avoided that the motor laterally protrudes over said drive wheel and the frame holding said drive wheel, into the elevator shaft.

This results in that the drive wheel can be accommodated between the shaft wall and the lifting passage passed by the elevator cabin and/or its elongation to bottom or top, however, the motor does not find sufficient room between the shaft wall and the lifting passage passed by the elevator cabin and/or its elongation to bottom or top on the side where the drive wheel is located. This obligatorily causes a restriction in flexibility of possible arrangeability of the motor. Correspondingly, the utility model cited in the beginning provides for that the motor is arranged in a pocket-like area above the shadow space of a door fighter profile or below the lower frame profile of a door.

Therefore, the present invention is based on the object of creating a holding and drive unit integrated into the elevator shaft, for an elevator cage, in which in spite of the use of a traditional drive motor an almost arbitrary arrangeability of the drive motor in the shaft is guaranteed.

The invention solves this object by means of an elevator whose support consists of at least one flat belt or synthetic rope which is directly wound around a part of the hub of the drive wheel, which part in the corresponding position has a sleeve-like section showing the required sheave profile. While the curve of traditional steel ropes during their deflection by means of a sheave must not be smaller than a given, not unsubstantial curve radius since otherwise the bending stress occurring in the steel ropes exceeds the maximally admissible limit for the demanded fatigue strength, flat belts or synthetic ropes can be guided over a sheave with a substantially smaller curve radius. Thereby it becomes possible to realize the sheave with a very small outer diameter by winding the flat belt directly

around the hub of the drive wheel. Due thereto in case of unchanged load of the support belt smaller torques occur on the sheave. The torque to be demanded from the drive motor decreases. Correspondingly, no motors can be used which also as standard motors are built sufficiently compact for allowing to be accommodated in very different positions in the elevator shaft.

Therein, it is particularly advantageous that now a drive motor of such size can be used whose width (including the pulley supported thereby) does not exceed the width of the drive wheel in axial direction. Thus, the drive motor can be accommodated on the same side as the drive wheel between the shaft wall and the lifting passage passed by the elevator cabin and/or its elongation to bottom or top.

Preferably, the drive motor at least partly is arranged within the pulley supported by it. This becomes possible as the pulley due to the lower drive speed to be created on said drive wheel can be embodied with a somewhat larger diameter, so that within the pulley sufficient room results for motor components. Thereby, additional constructional space is available for the motor.

In accordance with a further preferred embodiment the drive motor is an external rotor motor whose rotor outside is designed as pulley for the at least one drive belt. In such a construction the pulley does not require additional constructional space in axial direction of the motor, this again simplifying use of a standard motor.

An advantages further development provides for that the hub supporting the sheave profile is made in one piece. This includes the advantage that a separate sheave and thus an additional component causing costs and assembly time can be saved.

Preferably, the hub supporting the sheave profile, the circumferential frictional surface of the brake and the drive belt pulley are made in one piece. This saves further individual components causing additional costs. The drive wheel can, if required, be manufactured in rational manner and in a clamping by cutting operation from a precast or prewelded blank. The necessity of mutually centering individual components of the drive wheel quick running in accordance with the present invention, can be done without.

In particularly advantageous manner the pulley is embodied bent at right angle for forming an accommodation space for a braking means, i.e. it is composed of an inner section bent at right angle and a disc-shaped section subsequent thereto in radially outward direction, which has a wheel rim on its outer circumference, onto which act the drive belts. Thereby an annular accommodation room for the stationary components of a brake is created. The latter than will no longer protrude over the outer dimensions of the drive wheel.

If in advantageous manner in addition the section bent at right angle, on its outside forms the circumferential frictional surface of a drum brake or as alternative thereto the wheel rim onto which act the drive belts on its inside forms the circumferential frictional surface of a drum brake, the requirement to have to dispose an additional brake disk or brake drum on the hub can be done without. The constructional space additionally available thereby on the hub in axial direction is in particular in favor of the width of the drive belt.

By combining pulley and sheave with integration of the circumferential frictional surface of the brake to form a drive wheel a particularly flat unit can be manufactured which e.g. can also be arranged behind a

lateral vertical guide rail.

Further advantages and details result from the embodiments of the subject matter of the invention, shown in the drawing. The drawings shows the following:

FIG. 1 a longitudinal section through a shaft head in case of arrangement of the drive wheel and the drive motor in the shaft head region;

FIG. 2 a section along the line III – III in FIG. 1;

FIG. 3 a section along the line IV – IV in FIG. 1;

FIG. 4 the detail V from FIG. 1;

FIG. 5 a modification of FIG. 1, in which the motor was accommodated in an alternative position in the shaft head, using its now smaller structional size;

FIG. 6 a section of a constructional modification of the drive wheel;

FIG. 7 a section of a further constructional modification of the drive wheel;

FIG. 8 a further modification of FIG. 1, in which the motor was accommodated in an alternative position in the area of the lower shaft end, using its now smaller structional size;

FIG. 9 a last modification of FIG. 1, in which the motor was accommodated in an alternative position in the area of the lower shaft end, using its now smaller structional size.

In FIGs. 1 to 4 a first embodiment of the elevator 1 in accordance with the present invention, said elevator having a vertical shaft 2 for up- and downward movements of an elevator cabin 3. In the head section 4 of said shaft 2 the elevator drive consisting of a drive wheel 5 as well as a drive motor 6 acting thereon is arranged, wherein said drive, if required, of

course can also be accommodated in other positions in said shaft. Said drive motor 6 is embodied as external rotor motor, whose rotor outside in sections is realized as pulley for three parallel drive belts. Said shaft 2 is closed on top and on bottom and does not comprise a separate machine room.

The clear cross-section of said shaft is substantially larger than the cross-section of said elevator cabin, so that across the direction of movement of said elevator cabin on all sides a gap exists between said shaft wall and the passage passed by said elevator cabin.

Said drive wheel 5 has a hub 17 profiled as sheave (16) in one section. Over said section a flat belt 8 is wound. On said flat belt said elevator cabin 3 is suspended. Said flat belt 8 effects the lifting and lowering movements of said elevator cabin by running over the correspondingly driven sheave.

In addition said sheave 5 comprises a pulley 9 supporting a wheel rim 9 a on its outermost diameter, on whose outside drive belts 15 act. The inside of said wheel rim 9a is the frictional surface 10 of a brake drum formed by said wheel rim 9a. Brake shoes press in known manner (not shown in the Figs. in all details) on said frictional surface. Said brake shoes in the embodiments under FIGs. 1 to 4 are pressed to the inner surface of said wheel rim 9a by correspondingly pre-tensioned springs radially to the outside. During operation suitable brake cylinders (e.g. actuated hydraulically) hold said brake shoes in elevated position against the spring pretension.

Said pulley 9 and said sheave integrated into said hub 17 as well as said circumferential frictional surface 10 of said brake (no matter whether said frictional surface 10 now – as shown in this embodiment – is

integrated into said pulley 9 or is made available by a separately designed component like a brake disk 21) are combined to form a flat-structured drive wheel 5. Said drive wheel 5 is supported on a support frame 11 about a locally stable axis of rotation 12. To said support frame 11 a link 13 is connected, which carries said drive motor 6, said link 13 being charged via a tensioning spring 14 with a force which in the sense of tensioning the drive belt or belts 15 acts on said line 13. Of course, as tensioning spring not only the mechanical spring shown here comes into consideration but various known tensioning elements including hydraulically acting tensioning means.

Said axis of rotation 12 of said drive wheel 5 is arranged in the guide plane 25 of vertical guide rails 24 which are correlated to the vertical long central plane of said elevator cage 3 (FIG. 3). Said support frame 11 can be arranged in the space between said guide rail 25 and a lateral shaft wall 26 in room-saving manner.

In the embodiment represented by FIGs. 1 to 4 the shaft (not having an own reference number) of said drive motor 6 is arranged in parallel to the plane 20 (see FIG. 2) of doors 21 blocking admission to the shaft by stores. As it is a matter of a fast running drive motor which due to its high-speed capacity provides the required output also as comparatively small-size unit, said motor does not protrude over the plane 22 (see FIG. 2), i.e. over the plane created by the side of said support frame 11, facing the cabin, in direction of said elevator cabin.

Said motor 6 held on its outer circumference by means of said link 13, therefore, in the construction in accordance with the present invention need not be located above said door fighter profile 22, as shown in Fig. 1. Since due to the fact that said motor in the construction in accordance with the present invention does no longer protrude over said plane

22, now – if required – also said motor finds sufficient room on the same side as said drive wheel between said shaft wall and said movement passage of said elevator cabin and/or the virtual elongation of said passage to top or bottom. As is elucidated by the embodiment shown in FIG. 5, said motor (for example) can also be arranged by means of a corresponding link below the horizontally extending part of said support frame 11 in – with respect to FIG. 2 – right-hand side gap between said movement passage of said elevator cabin and said shaft wall closely above said door opening. Said motor in case of maintenance is better accessible in this position a.o. ?

As is elucidated by the embodiment modification shown in FIG. 8, the motor (also only as example) can be arranged also by means of a corresponding link closely above said shaft bottom between said guide rail and said shaft wall. In FIG. 8 a corresponding guide rail is shown in broken form for better survey. Said engine is located behind it and behind the continuation of said guide rail indicated in dots, seen from the point of view of the drawing plane.

In accordance with the modification shown in FIG. 9 said motor can also be arranged on the opposite side as compared to FIG. 8, below the threshold of said shaft door.

FIG. 4 as detail V (see marking of detail V in FIG. 1) shows the design of said drive wheel, its frame and said motor mounted thereon in more detail. The half of FIG. 4 lying above said bearing pin and/or said axis 13 shown a semisection (seen from top), the half of FIG. 4 lying below said bearing pin shows a top view, also seen from top.

It can be seen how said motor 6 embodied as external rotor motor with a pulley 6a arranged on its rotor outside is held on said frame 11

of said drive wheel via a link 13. Said drive wheel 5 is driven via three V-belts 15 acting in parallel. Said V-belts 15 are shown in broken view in the area of connection of said link 13, in order to release a view onto the connection of said link 13. Said hub 17 of said drive wheel 5 is supported on said bearing pin 12 representing the axis of rotation of said drive wheel and on both sides bearing on said support frame 11, via two rolling bearings.

Said elevator cabin is held and moved by flat belts 8. Said flat belt 8 is directly wound around said hub 17 which for this purpose on the position of winding has a section 16 comprising the required sheave profile for save accommodation of a flat belt. When using a flat belt 8 profiling essentially consists of two board-shaped protrusions arranged on both sides. As a rule said drive belt on its inside is sufficiently fictively (in any case if it is a matter of a synthetic surface), so that no particular rope grooves or the like have to be provided for in order to reliably avoid slipping of said flat belt. The section of winding 16 by said flat belt 8, of said hub 17 therein is embodied like a sleeve in the sense that a wheel rim representing a sheave in traditional sense, which is connected with the very hub via spokes or via a wheel disc as radial intermediate member and thus has a correspondingly large outer diameter is done without. Rather is the belt wound around a diameter of said hub located as close as possible to said axis of rotation. Said hub in this area is embodied with a wall thickness adequate with respect to points of view of strength and common increased factor of safety. Thus, the outer diameter of said sheave profile, which is in contact with said drive belt is essentially oriented on the outer diameter of (at least) the bearing located closest to said sheave profile. It is particularly advantageous to make the outer diameter of the profile being in contact with said drive belt not larger than appx. with a diameter corresponding to the 2 ½ fold outer diameter of the corresponding bearing.

As in this matter the drive belt force attack via a comparatively small lever arm on said sheave, in this construction the motor torque required for the drive is reduced.

In spite of the fact the a support belt 8 as compared to a traditional support rope needs an increased constructional place in parallel to its rolling axis, this does not result in that said drive wheel obligatorily and in disadvantageous manner has a broader construction in axial direction. Since due to the fact that a motor running more quickly running and correspondingly having a weaker torque can be used, also the demands to the belts connecting the motor and the drive pulley decrease – the pulling forces to be transmitted by the belts at simultaneous power flow substantially decrease with increasing speed. As a consequence it becomes possible to use narrower belts 15, thereby at least a great portion of the structural room additionally required for said drive belt 8 in axial direction is available.

In the embodiment shown in FIG. 4 said pulley 9 is slipped on a lateral flange of said hub 17 and there is secured in rotationally stable manner by means of a feather key e.g. and is axially fixed in traditional manner. Alternatively, said hub and said drive pulley are made in one piece from a precast or prewelded blank. This option is favored in that a flat belt or synthetic ropes in contrast to steel ropes do not wear said sheave (and/or the rope grooves possibly required there) and for this reason it no longer is obligatory that said sheave can be exchanged individually.

In the embodiment shown in FIG. 4 said wheel rim 9 a supporting said V-belts 15 on said drive pulley 9 is built such that on its inside he makes available for a brake drum said frictional surface 10. Said brake lining 19 held on a pin 18 can be pressed to the outside against said fric-

tional surface by an hydraulic or mechanical brake actuation mechanism. This construction includes the advantage that the braking forces attack at a very large lever arm, this being the reason why also in case of comparatively low actuation forces or a comparatively low dimensioned brake mechanism comparatively large braking moments can be realized.

FIG. 6 shows the area close to the axis, of a modified drive wheel construction. Components of identical function are denominated with identical reference numerals as in the preceding figures.

On said bearing pin 12 of said drive wheel 9 said hub 17 of said drive wheel 9 is supported by bearing 14. Said hub 17 carries a sheave profile 16 for a flat belt 8. Here, too, said flat belt is wound around a area located as close as possible to the axis, i.e. essentially predefined by the outer diameter of said bearings 15 and the wall thickness of said hub.

Said drive pulley 9 here, too, consists of an inner section 9a bent at right angle, which is followed by a disc-shaped section 9c which on its outer circumference carries said wheel rim 9a onto which act said drive belts 15. Said section bent at right angle here now is provided with a drum-shaped circumferential extension 9d. In this manner a brake drum results onto which brake shoes 19 can be pressed from the outside.

This modification has the following advantage. As already mentioned above, the comparatively low load of said belts 15 because of the reduced sheave diameter permits the use of comparatively narrow belts, this also resulting in a comparative narrow construction of said wheel rim 9a of said drive pulley. In addition, said sheave bears on an essentially smaller diameter than the outer diameter of said brake drum, i.e. the outer diameter of said extension 9d. Due thereto, it becomes possible that said brake shoes 19 protrude in axial direction laterally over said drive pulley 9

without being hidden in this area laterally by said sheave. This opens the possibility to actuate said brake shoe laterally past said wheel rim using a traditional jaw-like brake linkage and keep it in elevated position during operation. The oil or hydraulic pump for an hydraulic actuation otherwise to be accommodated in the shaft and in addition also being expensive can be done without, this also bringing about essential advantages. Said brake drum and/or said extension 9d therein are dimensioned so broad in advantageous manner that the torque caused by the asymmetric attach of the actuation force FBREMS which in tendency tilts said brake shoe is intercepted by said frictional surface 10.

FIG: 7 shows a narrow section of said drive wheel of a further constructional modification. Components of identical function again are denominated with reference numerals identical to reference numerals as used for the corresponding components precedingly.

On said bearing pin 12 here, too, a hub 17 is supported by bearing 14. Said hub 17 here again in an area close to the axis, essentially defined by the outer bearing diameter and the fall thickness of said hub carries a sheave profile 16 which here to is designed for receiving a flat belt 8. As a flat belt practically does not cause any wear in sheaves, it is possible to make said hub 17 at least in one part with said brake disc 21, possibility even with said drive sheave 9.

Brake linings 19 which under pretensioning are pressed against said brake disk and in operation are held in elevated position (preferably hydraulically), held in a brake caliper 20 act on said brake disk.

If in the individual embodiments an hydraulic brake actuation is provided for, a pressure agent reservoir (not shown) is installed so that also upon failure of a pump supplying said pressure agent, e.g. in case of

failure of electric supply, aeration of said brake is possible manually. Thereby, said elevator cage 3 can be moved into an arbitrary position, e.g. for salvage purposes e.g..